WHAT WE CLAIM IS:

1. A super hard and tough austenite steel bulk material with an improved corrosion resistance, comprising an aggregate of austenite nano-crystal grains containing a solid-solution type nitrogen in an amount of 0.1 to 2.0% (by mass), wherein a metal oxide or a semimetal oxide exists as a crystal grain growth inhibitor between or in said nano-crystal grains, or between and in said nano-crystal grains.

2. A super hard and tough austenite steel bulk material with an improved corrosion resistance, comprising an aggregate of austenite nano-crystal grains containing a solid-solution type nitrogen in an amount of 0.1 to 2.0% (by mass), wherein a metal nitride or a semimetal nitride exists as a crystal grain growth inhibitor between or in said nano-crystal grains, or between and in said nano-crystal grains.

3. A super hard and tough austenite steel bulk material with an improved corrosion resistance, comprising an aggregate of austenite nano-crystal grains containing a solid-solution type nitrogen in an amount of 0.1 to 2.0% (by mass), wherein a metal carbide or a semimetal carbide exists as a crystal grain growth inhibitor between or in said nano-crystal grains, or between and in said nano-crystal grains.

4. A super hard and tough austenite steel bulk material with an improved corrosion resistance, comprising an aggregate of austenite nano-crystal grains containing a

solid-solution type nitrogen in an amount of 0.1 to 2.0% (by mass), wherein a metal silicide or a semimetal silicide exists as a crystal grain growth inhibitor between or in said nano-crystal grains, or between and in said nano-crystal grains.

5. A super hard and tough austenite steel bulk material with an improved corrosion resistance, comprising an aggregate of austenite nano-crystal grains containing a solid-solution type nitrogen in an amount of 0.1 to 2.0% (by mass), wherein a metal boride or a semimetal boride exists as a crystal grain growth inhibitor between or in said nano-crystal grains, or between and in said nano-crystal grains.

6. A super hard and tough austenite steel bulk material with an improved corrosion resistance, comprising an aggregate of austenite nano-crystal grains containing a solid-solution type nitrogen in an amount of 0.1 to 2.0% (by mass), wherein at least two selected from the group consisting of (1) a metal oxide or a semimetal oxide, (2) a metal nitride or a semimetal nitride, (3) a metal carbide or a semimetal carbide, (4) a metal silicide or a semimetal silicide and (5) a metal boride or a semimetal boride exist as a crystal grain growth inhibitor between and/or in said nano-crystal grains.

7. The super hard and tough nano-crystal austenite steel bulk material with an improved corrosion resistance according to any one of claims 1 to 6, wherein said austenite steel bulk material comprising an aggregate

of austenite nano-crystal grains containing 0.1 to 2.0% (by mass) of a solid-solution type nitrogen contains in a structure thereof less than 50% of ferrite nano-crystal grains.

8. The super hard and tough nano-crystal austenite steel bulk material with an improved corrosion resistance according to any one of claims 1 to 7, wherein said bulk material comprising an aggregate of austenite nano-crystal grains containing 0.1 to 2.0% (by mass) of a solid-solution type nitrogen contains 0.1 to 5.0% (by mass) of nitrogen.

9. The super hard and tough nano-crystal austenite steel bulk material with an improved corrosion resistance according to any one of claims 1, 6 and 7, wherein said austenite steel bulk material comprising austenite nano-crystal grains containing 0.1 to 2.0% (by mass) of a solid-solution type nitrogen or an aggregate thereof contains 0.01 to 1.0% (by mass) of oxygen in a metal oxide or semimetal oxide form.

10. The super hard and tough nano-crystal austenite steel bulk material with an improved corrosion resistance according to any one of claims 2, 6, 7 and 8, wherein said bulk material comprising an aggregate of austenite nano-crystal grains containing 0.1 to 2.0% (by mass) of a solid-solution type nitrogen contains a nitrogen compound in an amount of 1 to 30% (by mass).

11. The super hard and tough nano-crystal austenite steel bulk material with an improved corrosion

resistance according to any one of claims 1 to 10, wherein said bulk material comprising an aggregate of austenite nano-crystal grains containing 0.1 to 2.0% (by mass) of a solid-solution type nitrogen comprises a nitrogen-affinity metal element that has a stronger chemical affinity for nitrogen than iron, such as niobium, tantalum, manganese, and chromium, so as to prevent denitrification during a forming-by-sintering process thereof.

12. The super hard and tough nano-crystal austenite steel bulk material with an improved corrosion resistance according to any one of claims 1 to 11, wherein said bulk material comprising an aggregate of austenite nano-crystal grains containing 0.1 to 2.0% (by mass) of a solid-solution type nitrogen has a steel forming and blending composition comprising 12 to 30% (by mass) of Cr, 0 to 20% (by mass) of Ni, 0 to 30% (by mass) of Mn, 0.1 to 5% (by mass) of N and 0.02 to 1.0% (by mass) of C with the rest being substantially Fe.

13. The super hard and tough nano-crystal austenite steel bulk material with an improved corrosion resistance according to any one of claims 1 to 9, wherein said bulk material comprising an aggregate of austenite nano-crystal grains containing 0.1 to 2.0% (by mass) of a solid-solution type nitrogen has a steel forming and blending composition comprising 12 to 30% (by mass) of Cr, 0 to 20% (by mass) of Ni, 0 to 30% (by mass) of Mn, up to 30% (by mass) of N (of a compound type) and 0.01 to 1.0% (by mass) of C with the rest being substantially Fe.

14. The super hard and tough nano-crystal austenite steel bulk material with an improved corrosion resistance according to any one of claims 1 to 11, wherein said bulk material comprising an aggregate of austenite nano-crystal grains containing 0.1 to 2.0% (by mass) of a solid-solution type nitrogen has a steel forming and blending composition comprising 4 to 40% (by mass) of Mn, 0.1 to 5% (by mass) of N, 0.1 to 2.0% (by mass) of C and 3 to 10% (by mass) of Cr with the rest being substantially Fe.

15. The super hard and tough nano-crystal austenite steel bulk material with an improved corrosion resistance according to any one of claims 1 to 11, wherein said bulk material comprising an aggregate of austenite nano-crystal grains containing 0.1 to 2.0% (by mass) of a solid-solution type nitrogen has a steel forming and blending composition comprising 4 to 40% (by mass) of Mn, up to 30% (by mass) of N (of a compound type), 0.1 to 2.0% (by mass) of C and 3 to 10% (by mass) of Cr with the rest being substantially Fe.

16. The super hard and tough nano-crystal austenite steel bulk material with an improved corrosion resistance according to any one of claims 1 to 15, wherein said austenite nano-crystal grains containing 0.1 to 2.0% (by mass) of a solid-solution type nitrogen have been obtained by mechanical alloying (MA) using a ball mill or the like.

17. The super hard and tough nano-crystal

austenite steel bulk material with an improved corrosion resistance according to any one of claims 1 to 16 which comprises an aggregate of austenite nano-crystal grains containing 0.3 to 1.0% (by mass) of a solid-solution type nitrogen and having a crystal grain diameter of 50 to 1,000 nm.

18. The super hard and tough nano-crystal austenite steel bulk material with an improved corrosion resistance according to any one of claims 1 to 16, which comprises an aggregate of austenite nano-crystal grains containing 0.4 to 0.9% (by mass) of a solid-solution type nitrogen and having a crystal grain diameter of 75 to 500 nm.

19. The super hard and tough nano-crystal austenite steel bulk material with an improved corrosion resistance according to any one of claims 1 to 16, which comprises an aggregate of austenite nano-crystal grains containing 0.4 to 0.9% (by mass) of a solid-solution type nitrogen and having a crystal grain diameter of 100 to 300 nm.

20. A process for preparing a nano-crystal austenite steel bulk material, which involves steps of:

mixing fine powders of respective austenite steel forming components such as iron and chromium, nickel, manganese, carbon or the like together with a substance that becomes a nitrogen source,

applying mechanical alloying (MA) to a mixture, using a ball mill or the like, thereby preparing fine

powders of nano-crystal austenite steel having a high nitrogen concentration, and

applying to said fine powders of said nano-crystal austenite steel forming-by-sintering treatment such as forming-by-sintering using one means selected from the group consisting of (1) rolling, (2) spark plasma sintering, (3) extrusion, (4) hot isostatic press sintering (HIP), (5) cold isostaticc pressing (CIP), (6) cold pressing, (7) hot pressing, (8) forging, and (9) swaging or two or more thereof in combination or explosive forming, thereby obtaining a super hard and tough austenite steel bulk material with an improved corrosion resistance, which comprises an aggregate of austenite nano-crystal grains containing 0.1 to 2.0% (by mass) of a solid-solution type nitrogen.

21. A process for preparing a nano-crystal austenite steel bulk material, which involves steps of:

mixing fine powders of respective austenite steel forming components such as iron and chromium, nickel, manganese, carbon or the like together with a substance that becomes a nitrogen source,

applying mechanical alloying (MA) to a mixture, using a ball mill or the like, thereby preparing fine powders of nano-crystal austenite steel having a high nitrogen concentration, and

applying to said fine powders of said nano-crystal austenite steel forming-by-sintering treatment in air, an oxidation-inhibition atmosphere or a vacuum such as at

least one means selected from the group consisting of (1) rolling, (2) spark plasma sintering, (3) extrusion, (4) hot isostatic press sintering (HIP), (5) hot pressing, (6) forging, and (7) swaging or two or more thereof in combination, or explosive forming, followed by quenching, thereby obtaining a super hard and tough austenite steel bulk material with an improved corrosion resistance, which comprises an aggregate of austenite nano-crystal grains containing 0.1 to 2.0% (by mass) of a solid-solution type nitrogen.

22. A process for preparing a nano-crystal austenite steel bulk material, which involves steps of:

mixing fine powders of respective austenite steel forming components such as iron and chromium, nickel, manganese, carbon or the like together with a substance that becomes a nitrogen source,

applying mechanical alloying (MA) to a mixture, using a ball mill or the like, thereby preparing fine powders of nano-crystal austenite steel having a high nitrogen concentration, and

applying spark plasma sintering to said fine powders of said nano-crystal austenite steel in a vacuum or an oxidization-inhibition atmosphere for forming-by-sintering, thereby obtaining a super hard and tough austenite steel bulk material with an improved corrosion resistance, which comprises an aggregate of austenite nano-crystal grains containing 0.3 to 1.0% (by mass)of a solid-solution type nitrogen, and having a crystal grain diameter of 50 to

1,000 nm.

23. A process for preparing a nano-crystal austenite steel bulk material, which involves steps of:

mixing fine powders of respective austenite steel forming components such as iron and chromium, nickel, manganese, carbon or the like together with a substance that becomes a nitrogen source,

applying mechanical alloying (MA) to a mixture, using a ball mill or the like, thereby preparing fine powders of nano-crystal austenite steel having a high nitrogen concentration, and

applying spark plasma sintering to said fine powders of said nano-crystal austenite steel in a vacuum or an oxidization-inhibition atmosphere for forming-by-sintering, followed by rolling and quenching, thereby obtaining a super hard and tough austenite steel bulk material with an improved corrosion resistance, which comprises an aggregate of austenite nano-crystal grains containing 0.3 to 1.0% (by mass) of a solid-solution type nitrogen, and having a crystal grain diameter of 50 to 1,000 nm.

24. The process for preparing a nano-crystal austenite steel bulk material according to claim 20 or 22, wherein said formed product is annealed at a temperature of 800 to 1,250℃ for 60 minutes or shorter, and further quenched.

25. The process for preparing a nano-crystal austenite steel bulk material according to claim 21 or 23,

wherein said quenched formed product is annealed at a temperature of 800 to 1,250℃ for 60 minutes or shorter, and further quenched.

26 The process for preparing a nano-crystal austenite steel bulk material according to any one of claims 20 to 25, wherein said substance that becomes a nitrogen source is one or two or more substances selected from the group consisting of N_2 gas, NH_3 gas, iron nitride, chromium nitride, and manganese nitride.

27. The process for preparing a nano-crystal austenite steel bulk material according to any one of claims 20 to 26, wherein an atmosphere in which said mechanical alloying is applied is any one gas selected from the group consisting of (1) an inert gas such as argon gas, (2) N_2 gas, and (3) NH_3 gas or a mixed gas of two or more gases selected from (1) to (3).

28. The process for preparing a nano-crystal austenite steel bulk material according to any one of claims 20 to 27, wherein an atmosphere in which said mechanical alloying is applied is an atmosphere of a gas with some reducing substance such as H_2 gas added thereto.

29. The process for preparing a nano-crystal austenite steel bulk material according to any one of claims 20 to 26, wherein an atmosphere in which said mechanical alloying is applied is a vacuum, an atmosphere with some reducing substance such as H_2 gas added to a vacuum or a reducing atmosphere.

30. The process for preparing a nano-crystal austenite steel bulk material according to any one of claims 20 to 29, wherein said respective austenite steel forming components such as iron and chromium, nickel, manganese, carbon or the like are mixed with 1 to 10% by volume of a metal nitride such as AlN, NbN, and Cr_2N or 0.5 to 10% (by mass) of a nitrogen affinity metal that has a stronger chemical affinity for nitrogen than iron, such as niobium, tantalum, manganese, chromium, tungsten, and molybdenum or cobalt together with said substance that becomes a nitrogen source, and said additive nitride is dispersed or said metal element or a nitride, carbo-nitride or the like thereof is precipitated and dispersed in a mechanical alloying (MA) process and a process of forming-by-sintering of mechanically alloyed (MA) powders, thereby obtaining a super hard and tough austenite steel bulk material having an improved corrosion resistance.

31. The process for preparing a nano-crystal austenite steel bulk material according to any one of claims 20 to 30, wherein said respective austenite steel forming components such as iron and chromium, nickel, manganese, carbon or the like are mixed with 1 to 10% by volume of a particle dispersant comprising a metal nitride such as AlN, NbN, TaN, Si_3N_4, and TiN together with said substance that becomes a nitrogen source, and crystal grains are more finely divided on a nano-size level in a mechanical alloying (MA) process and crystal grains are prevented from becoming coarse in a forming-by-sintering

process of mechanically alloyed (MA) powders, thereby obtaining a super hard and tough austenite steel bulk material having an improved corrosion resistance.

32. The process for preparing a nano-crystal austenite steel bulk material according to any one of claims 20 to 29 and 31, wherein respective fine powders of austenite steel-forming components for a high manganese-carbon steel type composed mainly of iron, manganese and carbon are mixed with fine powders of a metal nitride such as iron nitride that becomes a nitrogen source, mechanical alloying (MA) is applied to a mixture in an inert gas such as argon gas, a vacuum, a vacuum with some reducing substance such as H_2 gas added thereto or a reducing atmosphere, thereby preparing powers of nano-crystal austenite steel comprising 4 to 40% (by mass) of Mn, 0.1 to 5.0% (by mass) of N, 0.1 to 2.0% (by mass) of C and 3.0 to 10.0% (by mass) of Cr with the rest being substantially Fe, and forming-by-sintering treatment like hot forming-by-sintering such as sheath rolling, spark plasma sintering, and extrusion or explosive forming is applied to said powders of said austenite steel, thereby obtaining a super hard and tough austenite steel bulk material having an improved corrosion resistance.

33. The process for preparing a nano-crystal austenite steel bulk material according to any one of claims 20 to 32, wherein said austenite steel-forming and blending composition comprises 12 to 30% (by mass) of Cr, 0 to 20% (by mass) of Ni, 0 to 30% (by mass) of Mn, 0.1 to

5.0% (by mass) of N and 0.02 to 1.0% (by mass) of C with the rest being substantially Fe, and said forming-by-sintering is carried out at a temperature of 600 to 1,250℃.

34. The process for preparing a nano-crystal austenite steel bulk material according to any one of claims 20 to 31, wherein an amount of oxygen entrapped from a mechanical alloying vessel, hard steel balls or the like into said high-nitrogen nano-crystal austenite steel powders during mechanical alloying (MA) is adjusted to 0.01 to 1.0% (by mass), and a metal oxide or a semimetal oxide that is a compound of said oxygen is used to more finely divide crystal grains on a nano-size level in a mechanical alloying (MA) process, and prevent crystal grains from becoming coarse in a forming-by-sintering process of mechanically alloyed (MA) powders.

35. A high-strength bolt, nut or other mechanical clamping material, which is formed of the nano-crystal austenite steel bulk material according to any one of claims 1 to 19.

36. A bulletproof steel sheet, a bulletproof vest or other bulletproof material, which is formed of the nano-crystal austenite steel bulk material according to any one of claims 1 to 19.

37. A die, drill, spring, gear, bearing or other mechanical tool or part, which is formed of the nano-crystal austenite steel bulk material according to any one

of claims 1 to 19.

38. An artificial bone, joint, dental root or other medical or dental artificial material, which is formed of the nano-crystal austenite steel bulk material according to any one of claims 1 to 19.

39. An injection needle, surgical knife, catheter or other medical mechanical tool, which is formed of the nano-crystal austenite steel bulk material according to any one of claims 1 to 19.

40. A die used in many press operations (including blanking, drawing, forging, and forming), which is formed of the nano-crystal austenite steel bulk material according to any one of claims 1 to 19.

41. A hydrogen storage tank, which is formed of the nano-crystal austenite steel bulk material according to any one of claims 1 to 19.

42. A kitchen knife, razor, scissors or other sharp-edged tool, which is formed of the nano-crystal austenite steel bulk material according to any one of claims 1 to 19.

43. A turbine fin, turbine blade or other turbine member, which is formed of the nano-crystal austenite steel bulk material according to any one of claims 1 to 19.

44. A defensive weapon, which is formed of the nano-crystal austenite steel bulk material according to any one of claims 1 to 19.

45. A skating, sledging or other sporting member, which is formed of the nano-crystal austenite steel bulk

material according to any one of claims 1 to 19.

46. A pipe, tank, valve or other chemical plant material, which is formed of the nano-crystal austenite steel bulk material according to any one of claims 1 to 19.

47. An atomic power generator material, which is formed of the nano-crystal austenite steel bulk material according to any one of claims 1 to 19.

48. A rocket, jet or other flying object, which is formed of the nano-crystal austenite steel bulk material according to any one of claims 1 to 19.

49. A lightweight housing material for personal computers, attaché cases or the like, which is formed of the nano-crystal austenite steel bulk material according to any one of claims 1 to 19.

50. A member for moving equipments such as automobiles, ships and linear motorcars, which is formed of the nano-crystal austenite steel bulk material according to any one of claims 1 to 19.